MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2015/2016

TWM3431 – DIGITAL WATERMARKING

(All sections / Groups)

10 OCT 2015
9.00 a.m – 11.00 a.m
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 10 pages, including the cover page, with 10 MCQs and 6 questions only.

2. Attempt **ALL** questions in **Section A**.

3. Attempt **FIVE out of SIX** questions in **Section B**. All questions carry equal marks and the distribution of the marks for each question is given.

4. Please print all your answers in the Answer Booklet provided.

SECTION A: Attempt **ALL** multiple choice questions. [10 marks]

1. [True or False] The original unaltered work is sometimes referred to as payload.
   a. False
   b. True

2. [True or False] To view a watermarking system geometrically, the high-dimensional space in which each point corresponds to one work is referred to as marking space.
   a. False
   b. True

3. [True or False] Watermarked work with high fidelity must have high quality.
   a. False
   b. True

4. The two alternative, forced choice (dubbed as 2AFC) technique can be used to measure both fidelity and quality.
   a. False
   b. True

5. Transaction tracking is always known as fingerprinting because each copy of a work could be uniquely identified by the watermark.
   a. False
   b. True

6. _____watermarks are commonly used for tamper detection or commonly known as integrity proof.
   a. Imperceptible
   b. Fragile
   c. Visible
   d. Robust

7. The textual copyright notice for visual works can be any of the following, except:
   a. Copyright 2015 Elsa
   b. © 2015 Anna
   c. ® 2015 Ray
   d. Copr. 2015 Victor

Continued .....

8. The DVD player/recorder that implements watermarking and encryption is known as _____; while that does not implement watermarking and encryption is known as _____.
   a. blind; informed
   b. informed; blind
   c. compliant; non-compliant
   d. non-compliant; compliant

9. If the adversary obtains several different works that contain the watermark, he could perform _____.
   a. shoulder surfing attacks
   b. masquerade attacks
   c. collusion attacks
   d. denial of service attacks

10. In some applications, the minimal distortions introduced by embedding a small number of bit signature might be unacceptable, such as in medical application. Any modification of an image might become an issue in a malpractice suit. What is the alternative for content authentication in this case?
    a. Fragile watermarks
    b. Robust watermarks
    c. Erasable watermarks
    d. Embedded signature

Continued .....

SECTION B: Attempt **FIVE** out of **SIX** questions only

QUESTION 1

(a) Fill in the blanks with the appropriate watermarking terminologies:

i. _____: refers to the original unaltered work.

ii. _____: refers to the number of watermark bits within a unit of time, or within a work.

iii. _____: refers to the ability to detect the watermark after common signal processing operations

iv. _____: refers to the detector that requires access to the original or unwatermarked work.

v. _____: refers to the acts that embed illegitimate watermark into work that should not contain it.

[5 marks]

(b) "*The first line of defence against illegal copying is cryptography*".
Discuss whether cryptography could thoroughly protect copyrighted contents from piracy.

[3 marks]

(c) Digital watermarking is widely used by the industry for various purposes. Briefly explain the following watermarking applications:

i. Copy control

ii. Content authentication

[2 marks]

Continued .....

QUESTION 2

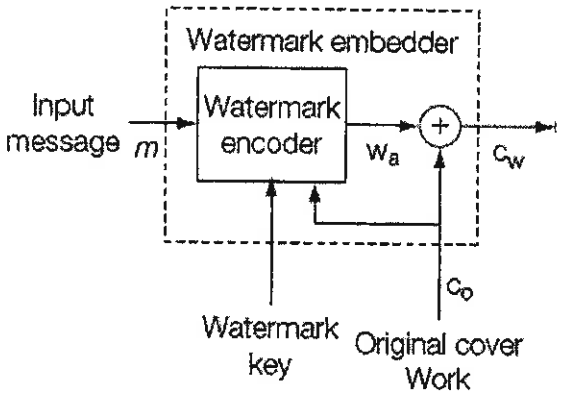
(a) Discuss the potential problems if the security of a cryptographic algorithm relies on keeping the algorithm secret.

[2 marks]

(b) In modern cryptographic and watermarking systems, security is derived from securing only the secret key, but not the entire algorithms. What are your opinions about the key-based cryptographic and watermarking systems?

[3 marks]

(c) The figure below illustrates the embedding process in a model of watermarking as communication with side information at the transmitter.



Given that it is using an informed detector, propose an equivalent watermark detector. Explain your answer with an appropriate diagram.

[3 marks]

(d) In copy control application, which kind of detection, i.e. informed detection or blind detection, is preferable? Justify your answer.

[2 marks]

Continued .....

QUESTION 3

(a) Differentiate direct message coding from multisymbol message coding.

[2 marks]

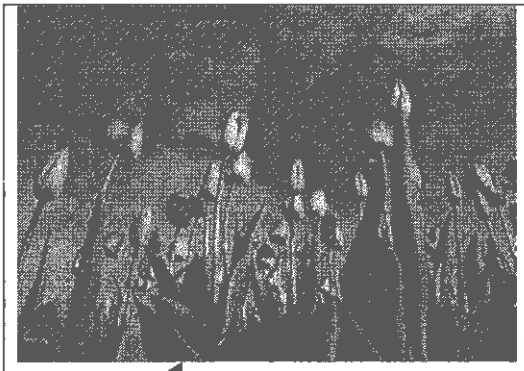
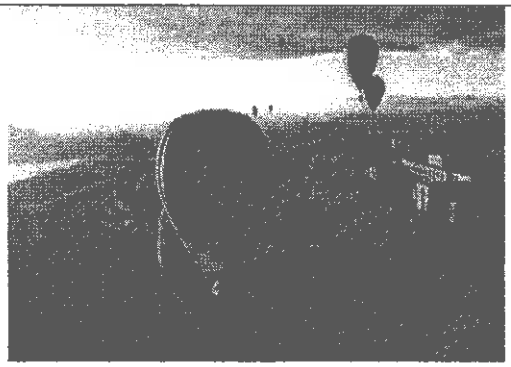
(b) If you are a digital watermarking designer, what are the key issues that you would consider when designing the message marks?

[3 marks]

(c) You have two sequences of symbols:

i. Sequence A consists of four symbols
ii. Sequence B consists of two symbols

You wish to spatially embed the two sequences, respectively, onto two images (i.e. tulip image and hot balloon image, as shown below) with size of 1024 by 1024 pixels. Suggest a way to accomplish this task.

 Sequence A	 Sequence B
Tulip image with size 1024 x 1024 pixels	Hot balloon image with size 1024 x 1024 pixels

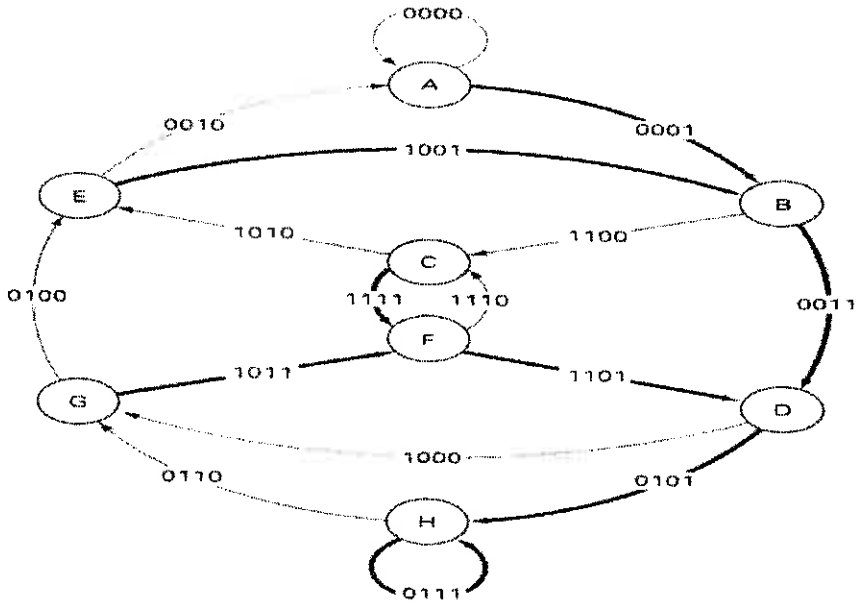
[3 marks]

Continued .....

(d) Referring to the figure below of Eight-Sate Convolutional Code, encode a 4-bit sequence of

i. 1010.

ii. 1111



[2 marks]

Continued .....

QUESTION 4

(a) Studies involving human evaluation should use a large number of subjects, and perform a large number of trials. Justify the reason behind this.

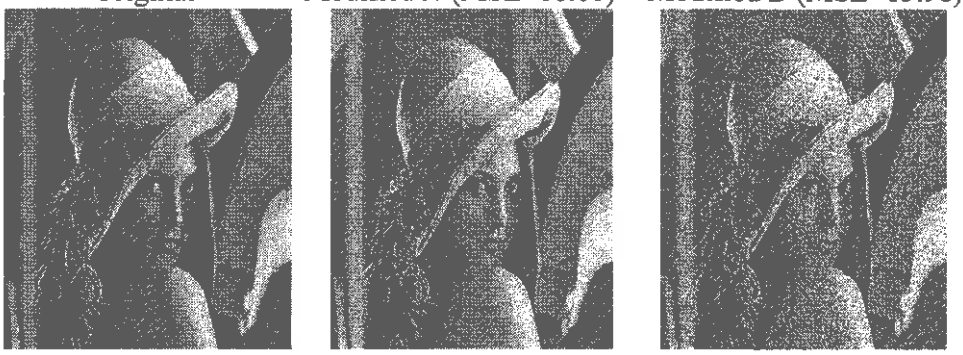
[3 marks]

(b) A classical experimental paradigm for measuring perceptual phenomena is the two alternatives, forced choice (2AFC). Describe this paradigm with an appropriate example.

[4 marks]

(c) When we refer to a "perceptual model", we mean more precisely a function $D(Co, Cw)$ that gives a measure of the perceptual distance between an original work, Co, and a watermarked work, Cw. Mean square error (MSE) is one of the simplest distance functions. Figure below illustrates an original image (Lena image) and its two modified images with the respective MSE scores. What is your observation and conclusion?

Original Modified A (MSE=16.01) Modified B (MSE=15.98)



[3 marks]

Continued .....

QUESTION 5

(a) Distinguish robust watermarks from secure watermarks. Elaborate the main reason why watermark robustness is a necessary property if a watermark is to be secure.

[3 marks]

(b) Spread spectrum communication is popular to produce a robust watermark. What are the TWO characteristics of spread spectrum communications that are important to watermarking?

[2 marks]

(c) If you are a watermarking designer, you always understand that it is better to place as much of the watermark as possible into reliable coefficients of a work's representation. How do you decide which coefficients of a work's representation are reliable, and which are not?

[2 marks]

(d) The often-used Lena image in image processing research is a cropped version of a 1972 Playboy centrefold, leaving only Lena's face and shoulder. Unfortunately, the text that identified Playboy as the owner was also cropped (see figure below). What strategy would you employ to handle this distortion? Explain your strategy.

[3 marks]

Continued .....

QUESTION 6

(a) Compare and contrast private watermarking from public watermarking.

[2 marks]

(b) Do you agree of appending the entire cover work to the embedded message before computing a cryptographic signature? Suggest a method that can be used to solve the limitation.

[3 marks]

(c) The encryption and watermarking layers can be viewed as analogous to two layers of a networking system: message and transport layers. Illustrate the two-layered watermarking system, and identify the major responsibility of message and transport layers.

[3 marks]

(d) What is an erasable watermark? Provide an application example that applies erasable watermark for content authentication.

[2 marks]

End of Paper